

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN FREDERICK ACKERMAN,
VENKAT SUBRAMANIAN VENKATARAMANI,
IRENE T. SPITSBERG,
BRETT ALLEN ROHRER BOUTWELL and
RAMGOPAL DAROLIA

Appeal 2006-2179
Application 10/735,369
Technology Center 1700

Decided: January 11, 2007

Before BRADLEY R. GARRIS, CHUNG K. PAK, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

PAK, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on an appeal from the Examiner's final rejection of claims 1 through 20 which are all of the claims pending in the above-identified application. We have jurisdiction pursuant to 35 U.S.C. § 134.

I. APPEALED SUBJECT MATTER

The subject matter on appeal is directed to providing a thermal barrier coating to an article, such as the components of a gas turbine engine. *See* Specification at 1-2. The method involves introducing “an effective surface-stabilization composition that inhibits sintering” of a primary ceramic coating defined by columnar grains on the components of the gas turbine engine. *Id.* The surface-stabilization composition comprises at least one Group 2 or 3 element of the Periodic Table, and at least one Group 5 element of the Periodic Table, with the Group 5 element being present from practically near zero (e.g., 100 billion to 3 atomic ratio) to about 75% based on atomic weight. *See, e.g.*, claims 1, 12, and 20. Details of the appealed subject matter are recited in representative claims 1, 12 and 20 which are reproduced below:

1. A method for preparing a protected article, comprising the steps of providing the article;
 depositing a bond coat onto an exposed surface of the article; and
 producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of
 depositing a primary ceramic coating onto an exposed surface of the bond coat, and
 depositing a stabilization composition onto an exposed surface of the primary ceramic coating, wherein the stabilization composition comprises a first element selected from Group 2 or Group 3 of the periodic table, and a second element selected from Group 5 of the periodic table, and wherein the atomic ratio of the amount of the first element to the amount of the second element is at least 1:3.

12. A method for preparing a protected article, comprising the steps of

providing a nickel-base superalloy article that is a component of a gas turbine engine;

depositing a bond coat onto an exposed surface of the article; and

producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of

depositing a yttria-stabilized zirconia primary ceramic coating onto an exposed surface of the bond coat, infiltrating a stabilization composition into an exposed surface of the primary ceramic coating, wherein the stabilization composition comprises a first element selected from Group 2 or Group 3 of the periodic table, and a second element selected from Group 5 of the periodic table, and wherein the atomic ratio of the amount of the first element to the amount of the second element is at least 1:3.

20. A method for preparing a protected article, comprising the steps of

providing the article;

depositing a bond coat onto an exposed surface of the article; and

producing a thermal barrier coating on an exposed surface of the bond coat, wherein the thermal barrier coating comprises a primary ceramic coating on the exposed surface of the bond coat, and

a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises a first element selected from Group 2 or Group 3 of the periodic table, and a second element selected from Group 5 of the periodic table, and wherein the atomic ratio of the amount of the first element to the amount of the second element is at least 1:3.

II. PRIOR ART

As evidence of unpatentability of the claimed subject matter, the Examiner relies upon the following references:

Taylor	US 5,520,516	May 28, 1996
Ackerman '633	US 2003/0059633 A1	Mar. 27, 2003
Subramanian	US 6,677,064 B1	Jan. 13, 2004
Ackerman '588	US 6,887,588 B2	May 3, 2005

III. REJECTION

The appealed claims stand rejected as follows:

- 1) Claims 1 through 20 under 35 U.S.C. § 103(a) as unpatentable over the disclosure of Ackerman '633;
- 2) Claims 1 through 12 and 14 through 20 under 35 U.S.C. § 103(a) as unpatentable over the disclosure of Subramanian;
- 3) Claim 13 under 35 U.S.C. § 103(a) as unpatentable over the combined disclosures of Subramanian and Taylor; and
- 4) Claims 1, 2, 5 through 12, and 15 through 20 under the judicially created doctrine of obviousness-type double patenting as unpatentable over the claims of Ackerman '588.

IV. FINDINGS AND CONCLUSIONS

We have carefully considered the claims, Specification and prior art references, including the arguments advanced by both the Appellants and the Examiner in support of their respective positions. This review has led us to conclude that the Examiner's § 103 rejections and obviousness-type double patenting rejection are well founded. Accordingly, we will sustain the Examiner's rejections for the factual findings and conclusion set forth in the Answer. We add following primarily for emphasis and completeness.

A. OBVIOUSNESS REJECTIONS

Under 35 U.S.C. § 103, the obviousness of an invention cannot be established by combining the teachings of the prior art references absent some teaching, suggestion or incentive supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). This does not mean that the cited prior art references must specifically suggest making the combination. *B.F. Goodrich Co. V. Aircraft Braking Systems Corp.*, 72 F.3d 1577, 1582, 37 USPQ2d 1314, 1318 (Fed. Cir. 1996); *In re Nilssen*, 851 F.2d 1401, 1403, 7 USPQ2d 1500, 1502 (Fed. Cir. 1988). Rather, the test for obviousness is what the combined teachings of the prior art references would have suggested to those of ordinary skill in the art. *In re Young*, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991); *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). In evaluating the prior art references for a suggestion, it is proper to take into account not only the specific teachings of the references, but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

In the rejecting the claims on appeal under 35 U.S.C. § 103, the Examiner has correctly found at pages 2 and 3 of the Answer that Ackerman '633 and Subramanian individually teach a method of protecting combustion gas turbine engine components made of, inter alia, a nickel-base superalloy, wherein the components are coated with an aluminum-containing bond coat or a diffusion aluminide prior to forming thermal barrier layers thereon. See Subramanian, column 4, lines 6-36, and Ackerman '633, page 1, paragraph 0007 and page 2, paragraphs 0023 and 0025. The thermal barrier layers are

formed by applying, on the aluminum-containing or diffusion aluminide bond coat, a yttria-stabilized zirconia ceramic thermal barrier coating material (a base layer) and then sintering inhibitor precursor materials (an overlay layer). *See* Ackerman '633, page 1, paragraphs 0008- 0009 and page 4, paragraphs 0028-0032, Subramanian, column 4, lines 41-57 and column 5, lines 43-66. One or more sintering inhibitor precursors can be applied in a nonsolid (liquid or gaseous) form (which indicates that two or more inhibitor precursors may be deposited together in liquid form). *See, e.g.,* Ackerman '633, page 5, paragraph 0036. The yttria-stabilized zirconia taught by Ackerman '633 contains about 3 percent to about 12 percent yttria by weight as required by claim 13 on appeal. *See* page 4, paragraph 28. Moreover, Taylor also teaches the importance of having about 6.5 to 9 percent yttria by weight in the yttria-stabilized zirconia thermal barrier coating of the type employed in Ackerman '633 or Subramanian as required by claim 13 on appeal to obtain extraordinary good VWR (volume wear ratio) for the nickel alloy blades for turbine engines. *See* Taylor, column 5, lines 24-39, column 6, lines 63-67 and column 7, lines 15-30.

The dispositive question is, therefore, whether it would have been obvious to apply Group 2 or 3 element and Group 5 element in an atomic ratio of **at least** 1:3 on the yttria-stabilized zirconia ceramic thermal barrier material coated on the gas turbine engine components. On this record, we answer this question in the affirmative.

As indicated *supra*, the claimed surface-stabilization composition comprises at least one Group 2 or 3 element, and at least one Group 5 element of the periodic table, with the Group 5 element being present from practically near zero (e.g., 100 billion to 3 atomic ratio) to about 75% based

on atomic weight. We observe that Ackerman '633 teaches at paragraph 0032 that:

The sintering inhibitor slows and preferably prevents the sintering process which reduces and eventually eliminates the gaps 50. The sintering inhibitor is a reaction product, which may or may not be a stoichiometric chemical compound, of the thermal barrier coating material and an inhibitor precursor material that is added to the thermal barrier coating 46 after its deposition. The inhibitor precursor material preferably includes an inhibitor element selected from the group consisting of **barium, strontium, tantalum, lanthanum, neodymium, gadolinium, niobium, and mixtures thereof**, so that the sintering inhibitor is a compound of one or more of these inhibitor elements. (Emphasis added.)

Of the seven preferred precursors listed, niobium and tantalum are from Group 5 of the Periodic Table and the remaining five preferred elements are from Group 2 or 3 of the Periodic Table. They, like the Appellants' stabilization composition, are used to inhibit sintering as indicated *supra*. Thus, we concur with the Examiner that the Ackerman '633 disclosure would have led one of ordinary skill in the art to employ specifically mentioned Groups 2, 3 and 5 elements individually or in mixtures inclusive of the claimed mixture, motivated by a reasonable expectation of successfully providing an effective sintering inhibition property. *Merck & Co. v. Biocraft Laboratories Inc.*, 874 F.2d 804, 807, 10 USPQ2d 1843, 1846 (Fed. Cir.), *cert. denied*, 493 U.S. 975 (1989); *In re Peterson*, 315 F.3d 1325, 1329, 65 USPQ2d '1379, 1382 (Fed. Cir. 2003).

Similarly, we observe that Subramanian teaches at column 5, lines 43-66, that:

The overlay layer **32** is deposited as a precursor coating on top of the underlying base layer **28** via a process that allows

for topside deposition and infiltration in between the PVD deposition gaps or cracks, or the APS deposited cracks or pores....

Like with base layer **28**, the overlay layer **32** can be a single-oxide having the chemical formula denoted by C_wO_z , where C is selected from the group consisting of: Al, Ca, Mg, Zr, Y, Sc, La, Ce, Pr, Nd, P, Sm, Eu, Gd, Dy, Ho, E, T, Yb, Ta, Nb [and] combinations thereof and the like....

Alternatively, the overlay layer **28** [sic., **32**] can be a mixture of two oxides having the chemical formula denoted by $C_{w1}O_{z1}$ and $D_{w11}O_{z11}$ or more simply $(C, D)_wO_z$, where C and D are selected from the group consisting of : Al, Ca, Mg, Zr, Y, Sc, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Dy, Ho, Er, Tm, Yb, Ta, Nb [and] combinations thereof and the like...

Of the materials specifically listed, Ta and Nb are from Group 5 of the Periodic Table and Al, Ca, Mg, Y, Sc, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Dy, Ho, Er, Tm, and Yb are from Group 2 or 3 of the Periodic Table. See the Periodic Table. We observe that Subramanian further teaches at column 7, lines 10-17, that:

The materials or compositions **28**, **32** are advantageously selected based on their phase stability and possible reaction products. The reaction products **32'** that subsequently form part of the TBC **20** are selected such that they are phase stable to high temperatures, possess low thermal conductivity and have a low tendency to sinter. In addition, the reaction product **32'** can be selected to provide improved corrosion and erosion resistance.

Thus, we determine that the selection of the optimum amounts of the elements specifically listed in Subramanian to arrive at the claimed stabilization composition is well within the ambit of one of ordinary skill in the art since Subramanian recognizes such selection to be a result effective variable. *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA

1980) (“[D]iscovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art.”); *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955)(“[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”).

Thus, for the factual findings in the Answer and above, we determine that the Examiner has established a prima facie case of obviousness regarding the claimed subject matter which has not been sufficiently rebutted by the Appellants. Hence, we hold that the preponderance of evidence weighs most heavily in favor of obviousness within the meaning of 35 U.S.C. § 103. Accordingly, we affirm the Examiner’s decision rejecting the claims on appeal under 35 U.S.C. § 103.

B. OBVIOUSNESS-TYPE DOUBLE PATENTING REJECTION

Under the Judicially-created doctrine of obviousness-type double patenting, a patentee is prohibited from obtaining an unjustified timewise extension of the right to exclude granted through claims in a later patent application that are not patentably distinct from claims in a commonly-owned earlier patent. *Eli Lilly & Co. v. Barr Laboratories, Inc.*, 251 F.3d 955, 967, 58 USPQ2d 1869, 1877-78 (Fed. Cir. 2001); *In re Longi*, 759 F.2d 887, 892, 225 USPQ 645, 648 (Fed. Cir. 1985) (quoting *In re Zickendraht*, 319 F.2d 225, 232, 138 USPQ 22, 27 (CCPA 1963)(“The public should also be able to act on the assumption that upon *expiration* of the patent it will be free to use not only the invention claimed in the patent but also any modifications or variants thereof which would have been *obvious* to those of ordinary skill in the art at the time the invention was made, taking into account the skill of the art and prior art other than the invention claimed in

the issued patent.”)). The fundamental reason for the doctrine of obviousness-type double patenting is to prevent unjustified timewise extension of the right to exclude granted by a patent, regardless of how the extension arose. *Eli Lilly*, 251 F.3d at 967-68, 58 USPQ2d at 1878.

To determine whether obviousness-type double patenting exists between claims, we must compare claim elements in a side-by-side fashion. *See, e.g., Georgia Pacific Corp. v. U.S. Gypsum Co.*, 195 F.3d 1322, 1326-29, 52 USPQ2d 1590, 1593-96 (Fed. Cir. 1999). We must keep in mind that “a double patenting rejection of the obviousness type rejection is ‘analogous to a [failure to meet] the nonobviousness requirement of 35 U.S.C. § 103.’” *Longi*, 759 F.2d at 892 n.4, 225 USPQ at 648 n.4.

Here, representative claim 1 on appeal recites:

1. A method for preparing a protected article, comprising the steps of providing the article;
 depositing a bond coat onto an exposed surface of the article; and
 producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of
 depositing a primary ceramic coating onto an exposed surface of the bond coat, and
 depositing a stabilization composition onto an exposed surface of the primary ceramic coating, wherein the stabilization composition comprises a first element selected from Group 2 or Group 3 of the periodic table, and a second element selected from Group 5 of the periodic table, and wherein the atomic ratio of the amount of the first element to the amount of the second element is at least 1:3.

Claims 14, 15 and 16 Ackerman '588 recites as follows:

14. A method for fabricating an article protected by a thermal barrier coating system, comprising the steps of
 providing a substrate having a substrate surface; and
 applying a thermal barrier coating system overlying the substrate by the steps of
 depositing onto the substrate surface a thermal barrier coating system comprising a thermal barrier coating material arranged as a plurality of columnar grains extending generally perpendicular to the substrate surface and having grain surfaces and gaps between the columnar grains, and
 producing a sintering inhibitor within the columnar grains but concentrated at the grain surfaces, wherein the sintering inhibitor has a higher melting point than the thermal barrier coating material, and wherein the step of producing includes the steps of liquid phase infiltrating an inhibitor precursor material into the gaps of the thermal barrier coating, wherein the step of infiltrating comprises the steps of forming a liquid solution containing the inhibitor precursor material dissolved in a solvent, and contacting the liquid solution to the thermal barrier coating, and
 chemically reacting the infiltrated inhibitor precursor material and the thermal barrier coating material to form the sintering inhibitor.
15. The method of claim 14, wherein the step of applying includes the steps of
 depositing a bond coat overlying the substrate, and
 thereafter depositing the thermal barrier coating overlying the bond coat.
16. The method of claim 14, wherein the step of applying includes the step of
 providing an inhibitor precursor material comprising an inhibitor element selected from the group consisting of barium, strontium, tantalum, lanthanum, neodymium, ytterbium, gadolinium, niobium, and mixtures thereof.

Niobium and tantalum are Group 5 elements of the Periodic Table and barium, strontium, lanthanum, neodymium, ytterbium and gadolinium are Groups 2 and 3 elements of the Periodic Table.

The Examiner has recognized that claims 14 through 16 of Ackerman '588 fail to recite that their substrate is made of a nickel-base superalloy as recited in claim 2 on appeal and that their thermal barrier coating material is made of yttria-stabilized zirconia as recited in claim 5. To remedy these deficiencies, the Examiner has taken official notice that these features are well known in the art. Indeed, they are conventional in the method of the type recited in claims 14 through 16 of Ackerman '588 as is apparent from the Appellants' own Specification (pages 1, 5, and 6) and the prior art of record relied upon by the Examiner (cols. 1 and 3 of Taylor, col. 1 of Subramanian and page 1 of Ackerman '633).

Thus, the dispositive question is whether it would have been obvious to apply a Group 2 or 3 element and a Group 5 element in an atomic ratio of **at least** 1:3 on the thermal barrier layer. On this record, we answer this question in the affirmative for the same reasons indicated *supra*. Claim 16 of Ackerman '588, like the disclosure of Ackerman '633 or Subramanian, recites a very limited number of Group 2, 3 and 5 elements which can be used individually or in a mixture for the same purpose taught in the Appellants' Specification, i.e., inhibit sintering.

Thus, for the fact findings set forth in the Answer and above, we affirm this obviousness-type double patenting rejection as well.

V. CONCLUSION

The decision of the Examiner is affirmed.

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VI. TIME PERIOD

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

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